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HIGH IMPACT SHOCK TESTS ON TOGGLE SWITCHES - MICRO SWITCH CORPORATION, FREEPORT - HSM807-017

Evaluation Report No. - ETL-2004

10 October 1958

APPROVAL INFORMATION

Submitted by

B. SHEA
Electrical Engineer

Approved by

A. W. CROCKER
Electrical Engineer

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

BUSHIPS ltr S62/2-1(665J); ser 665-3141 of 31 Jul 1956
Index No. NS9567-017
ETL Report 2904

Date: 10 Oct 1958

Report of Tests

on

Toggle Switches

submitted by

Micro Switch Corporation, Freeport, Illinois

Ref: (a) BUSHIPS ltr S62/2-1(665J); ser 665-3141 of 31 Jul 1956
(b) BUSHIPS ltr S62/2-1(565J); ser 565-2114 of 24 Jun 1957
(c) BUSHIPS ltr S62/2-1(565J); ser 565-4387 of 18 Nov 1957
(d) Specification MIL-S-901B of 19 Dec 1955
(e) PTSNAVSHIPYD ltr 380; 88/S62/2-1(29813) of 28 Aug 1957, forwarding ETL Report No. 2726 to BUSHIPS (Code 312)

Encl: (1) Photograph showing six types of toggle switches as received for tests - Negative No. 3153
(2) Photograph showing five types of toggle switches as received for tests - Negative No. 3154
(3) Photograph showing six types of toggle switches as received for tests - Negative No. 3155
(4) Photograph showing three types of toggle switches as received for tests - Negative No. 3156
(5) Oscillograms showing contact opening or transfer during high impact shock test
(6) Photograph showing typical failures encountered during high impact shock test - Negative No. 3174
(7) Tabulated results of high impact shock tests

1. Authority - reference (a)

Priority - Regular
Index No. - NS9567-017
Cost classification - Allotment 42291/sPN59.23

Enclosure (1)

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

Subj: Test 3994; Toggle switches; NS1057-017

Date samples received -	13 August 1958
Date tests started -	22 September 1958
Date tests completed -	30 September 1958

2. Purpose - The purpose of this investigation was to ascertain which of the standard toggle switches would withstand the high impact shock requirements of reference (d).

3. Description of Material - The material received for tests comprised two each of the following switches, manufactured by Micro Switch Corporation:

Manufacturer's Type	AN Type	MS Type	JAN Type
11T01-1	3021-1	35059-21	ST40E
11T01-3	3021-3	35059-23	ST40D
11T01-21	3021-10	35059-24	-
31T01-3	3022-3	25102-23	ST45D
32T01-1	3023-1	25103-21	T855P
32T01-3	3023-3	25103-23	T855N
32T01-21	3023-11	25103-24	-
12T01-1	3027-1	35059-21	ST50P
12T01-3	3027-3	35059-23	T850N
12T01-21	3027-9	35059-24	-
33T01-1	3226-1	25103-21	-
33T01-3	3226-3	25103-23	-
33T01-21	3226-4	25103-24	-
1T1-1			
1T1-3			
1T1-21			
2T1-1			
2T1-3			
3T1-21			
31T01-21			

Photographs, enclosures (1) thru (4), illustrate one sample of each of the twenty types of switches received for tests.

4. Methods of Tests - The switch samples were mounted on a steel plate, as shown on figure 69 of reference (d), and were subjected to impacts of 400, 1200 and 2000 foot-pounds, applied one each from the back, top and side of the equipment. Test on any sample was dis-

continued if failure occurred. For the types of switches with a locking "On" position, one sample was checked in the "On" position, and the other sample was tested in the "Off" position. After each blow, circuit continuity was checked. A Brush recorder was connected in the circuit to register contact opening or transfer during each impact on each switch.

5. Results of Tests - The results of tests are tabulated on enclosure (7). These results may be summarized briefly, as follows:

a. Of the one sample of each type of switch tested in the normally closed position, an indication of contact bounce and/or switch opening was noted on each type as a result of some one or more of the nine impacts delivered to each sample.

b. Of the one sample of each type of switch tested in the normally open position, only seven types, namely, 2TL1-3, 2TL1-21, 11T81-1, 32T81-1, 33T81-1, 33T81-3 and 33T81-21, mal-functioned. The mal-functioning included fractures, stripping of the shaft threads, loss of circuit continuity and inability to operate the switches manually.

Oscillograms were taken of each impact, but to eliminate including 180 such oscillograms in the report, only typical sheets are included, covering at least one impact on each type of switch. The remaining oscillograms are on file in the laboratory and will be forwarded on request. Photograph, enclosure (6), indicates typical failures occurring on the switch samples.

6. Conclusions - Based on the results of tests on sample toggle switches, it may be concluded that

a. each type of the 20 types of toggle switches, when tested in the normally closed position, would not be satisfactory for use in vital circuits because of momentary contact bounce during high impact shock test.

b. toggle switches, types 2TL1-3, 2TL1-21, 11T81-1, 32T81-1, 33T81-1, 33T81-3 and 33T81-21, were unsatisfactory because of structural and/or mechanical failures.

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

Subj: Test 2924; Toggle switches; NSN607-017

7. Discussion - Letter, reference (a), forwarded two samples each of 20 types of toggle switches, manufactured by Micro Switch Corporation, for shock resistance evaluation. References (b) and (c) authorized tests on only three and four pole switches, under the premise that if these passed, the single and double pole switches would be adjudged shock resistant. However, because of the failures reported by reference (c), the Bureau requested evaluation of the manufacturer's one and two pole switches.

The switches, as received, contained two samples each of the twenty types listed under "Description of Material". Consequently, one sample of each type was connected in a circuit to provide any indication of contact bounce of the normally closed contacts during high impact shock, while the duplicate sample was connected to indicate any momentary closing or transfer of the normally open contacts. Oscillograms were recorded of each impact on each switch sample. The records have been retained in the laboratory for record purposes, since no advantage would be gained by including in the report the 150-odd oscillograms. Typical records showing at least one impact on each of the twenty types of switches have been included as enclosure (3). These oscillograms indicate contact bounce on one or more impacts on all samples tested with the contacts normally closed, as well as operation of the switch from the normally closed to the open position. Thirteen of the twenty types of switches tested in the open position did not indicate any damage or contact bounce. The seven remaining types mal-functioned.

6. Recommendations - On the basis of tests, as conducted, it is recommended that

a. none of the twenty types of toggle switches be considered suitable for use in vital shipboard circuits because of momentary contact bounce and/or switch transfer from "on" to "off".

b. the types 2TL1-3, 2TL1-21, 11T51-1, 33T01-1, 33T01-2, 33T01-3 and 33T01-21 switches be considered unsatisfactory because of fracture or/and mechanical or electrical mal-functioning.

7. Abstract - Two each of twenty types of toggle switches, manufactured by Micro Switch Corporation, and submitted as enclosure (1) of reference (a), were received for shock resistance evaluation.

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

Subj: Test 2994; Toggle switches; NSN5G7-017

Samples were subjected to high impact shock in accordance with reference (d), with oscillogram recordings taken of each impact. Results indicated seven types to be unsatisfactory because of fractured housings or other mal-functioning. The remaining types indicated contact bounce and/or switch operation from "on" to "off" as a result of impact and were recommended as unsatisfactory for use in vital circuits. Switches are being returned to the Bureau of Ships as enclosure (8) of letter forwarding this report for examination and disposition.

ASC-9-5-58 - 3153

VIEW OF MICRO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION

1TL1-1
2TL1-1

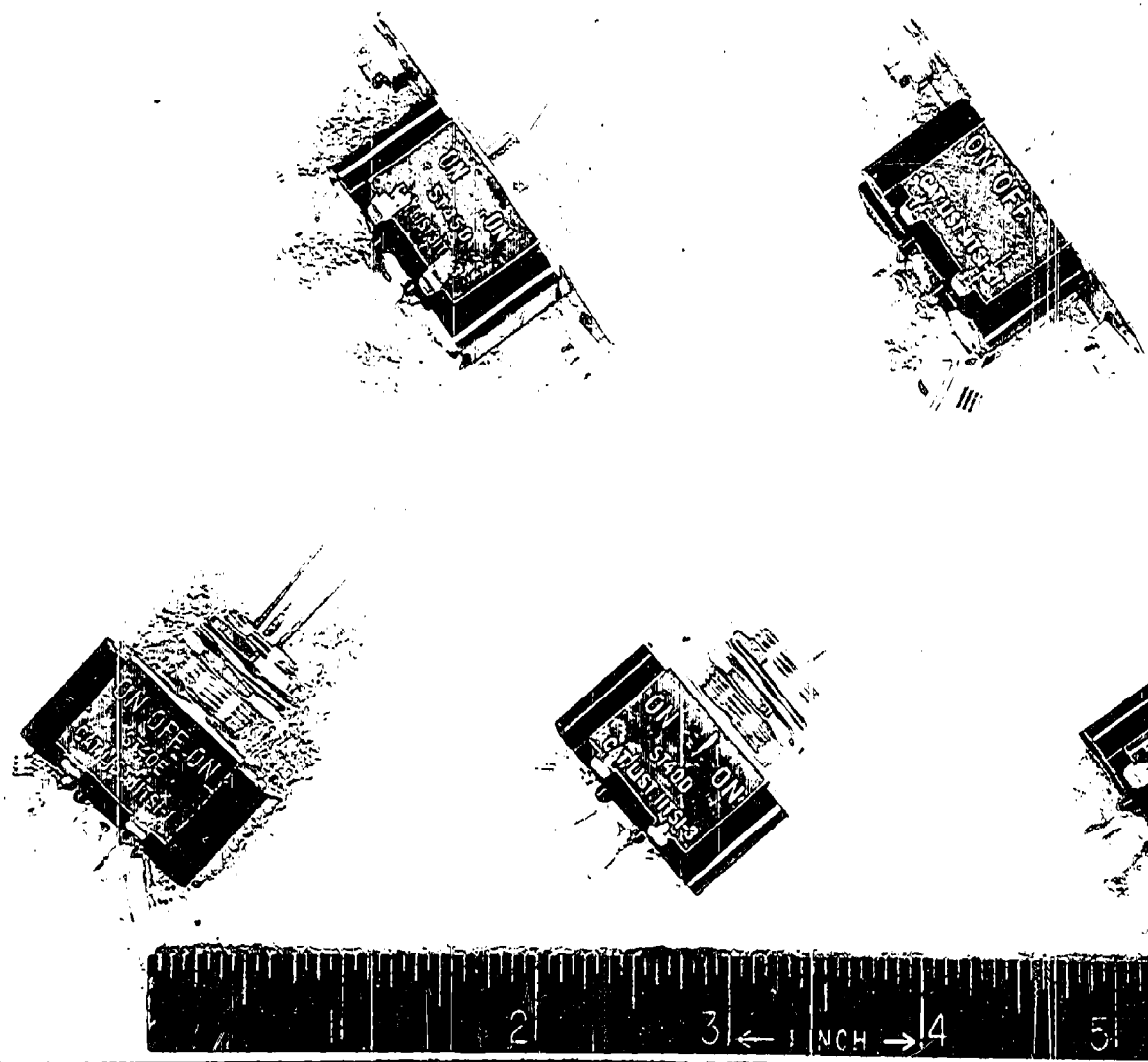
1TL1-3
2TL1-3

1TL1-21
2TL1-21

NSM687-017

TEST NO. 2994

ENCLOSURE (1)



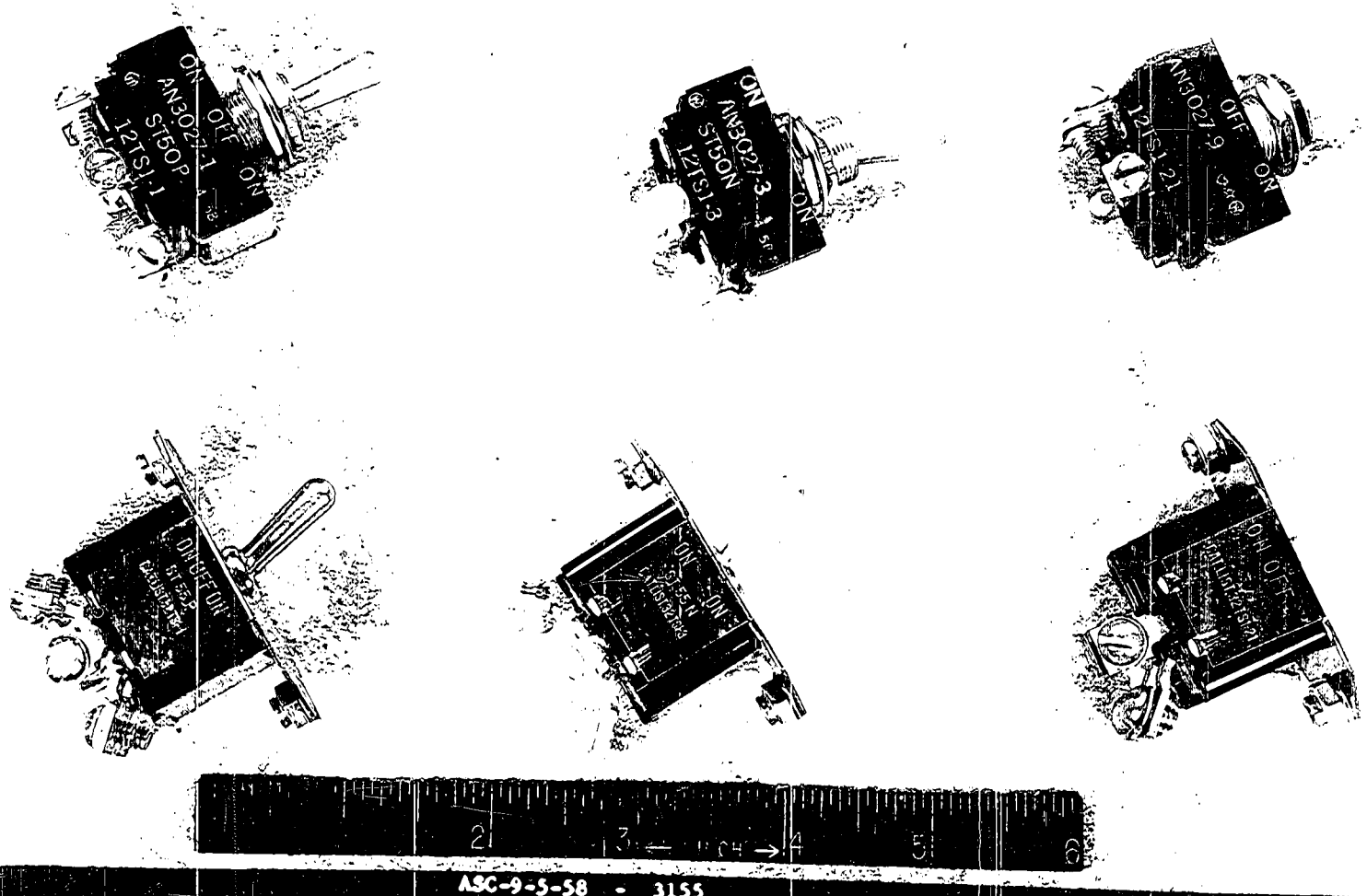
ASC-9-5-58 - 3154

VIEW OF MICRO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION

31TS1-3 31TS1-21

11TS1-1 11TS1-3 11TS1-21

[redacted]-017 TEST NO. 2994 ENCLOSURE (2)



ASC-9-5-58 - 3155

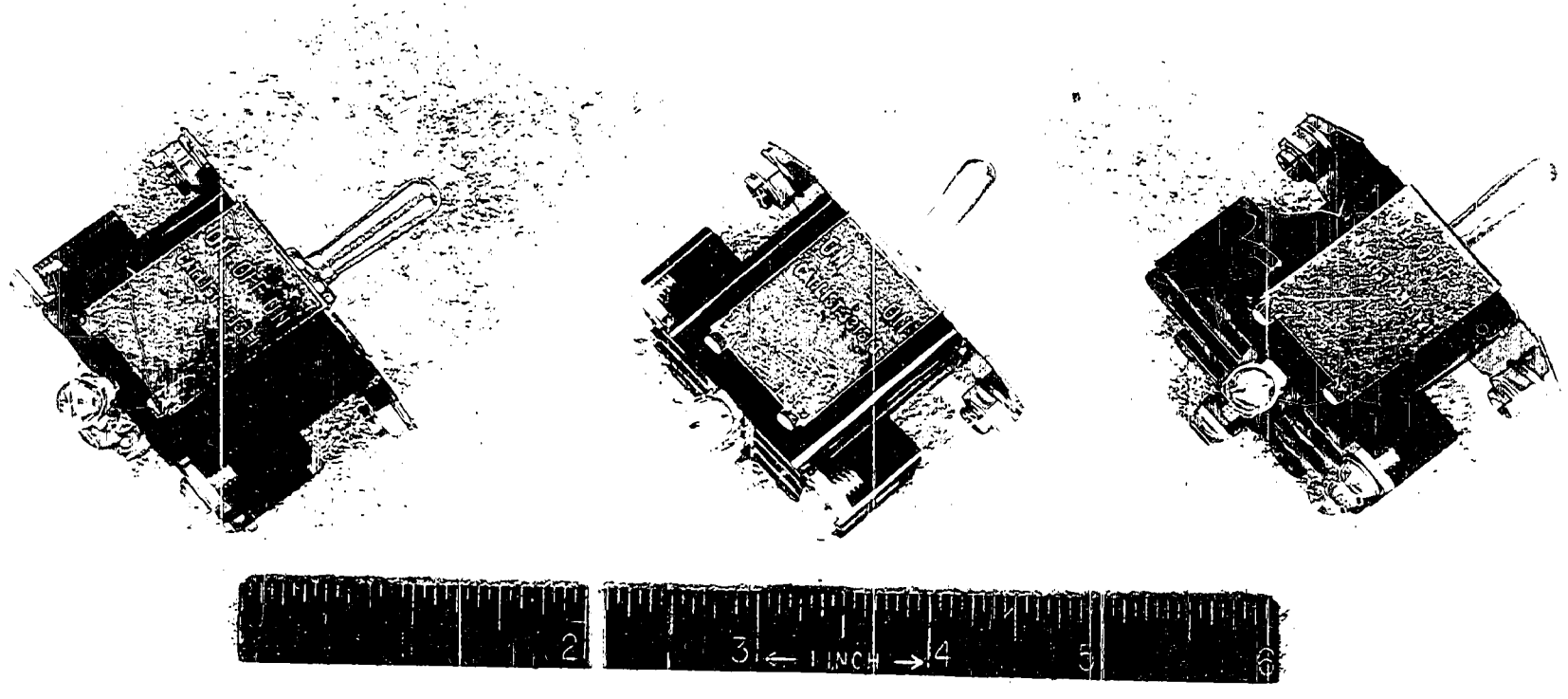
VIEW OF MICRO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION

12TS1-1 32TS1-1	12TS1-3 32TS1-3	12TS1-21 32TS1-21

NBS687-017

TEST NO. 2994

ENCLOSURE (3)



SC-9-5-58 - 3156

VIEW OF MICRO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION

33TS1-1

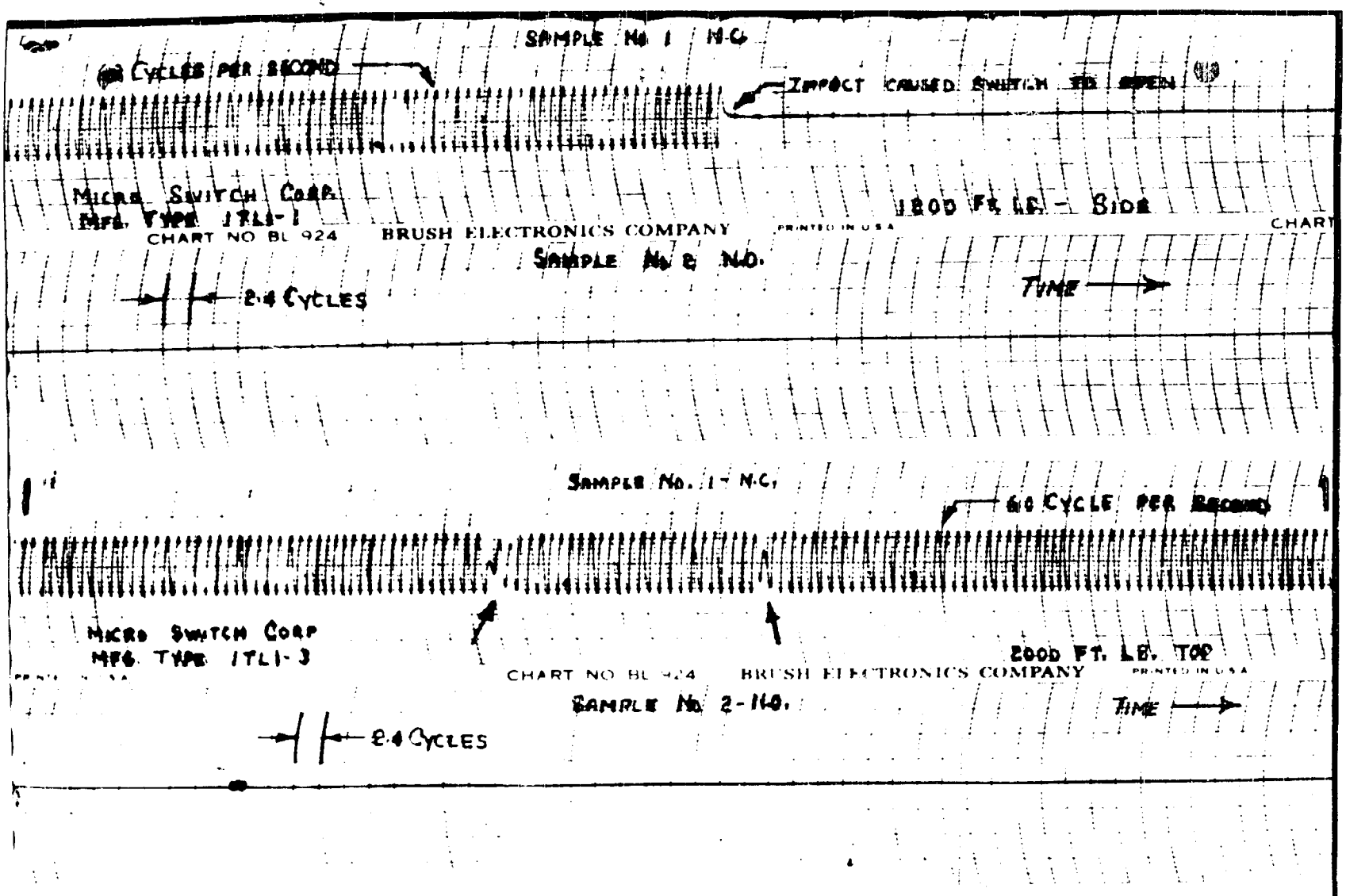
33TS1-3

33TS1-21

MSM687-017

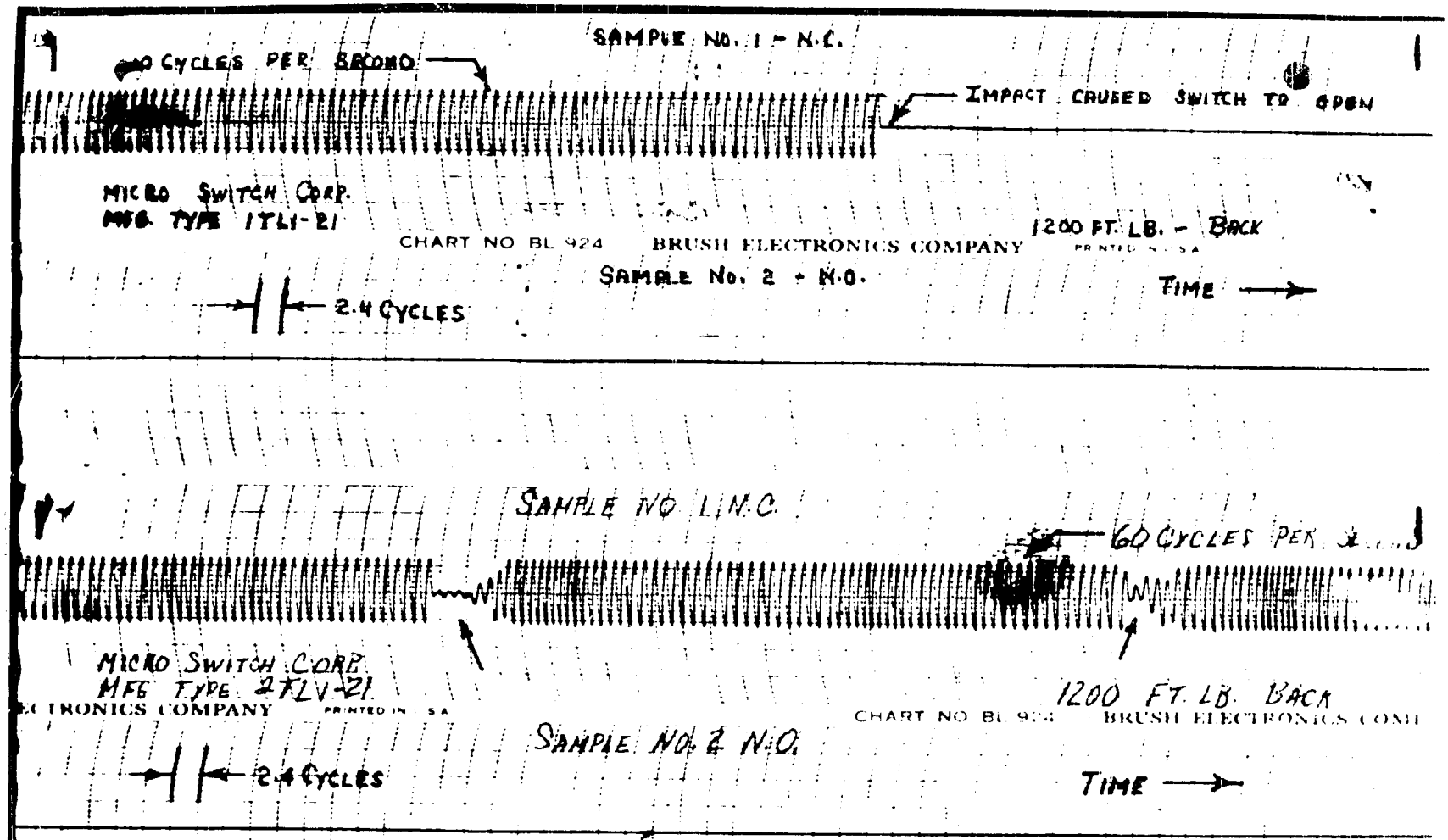
TEST NO. 2994

ENCLOSURE (6)



OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

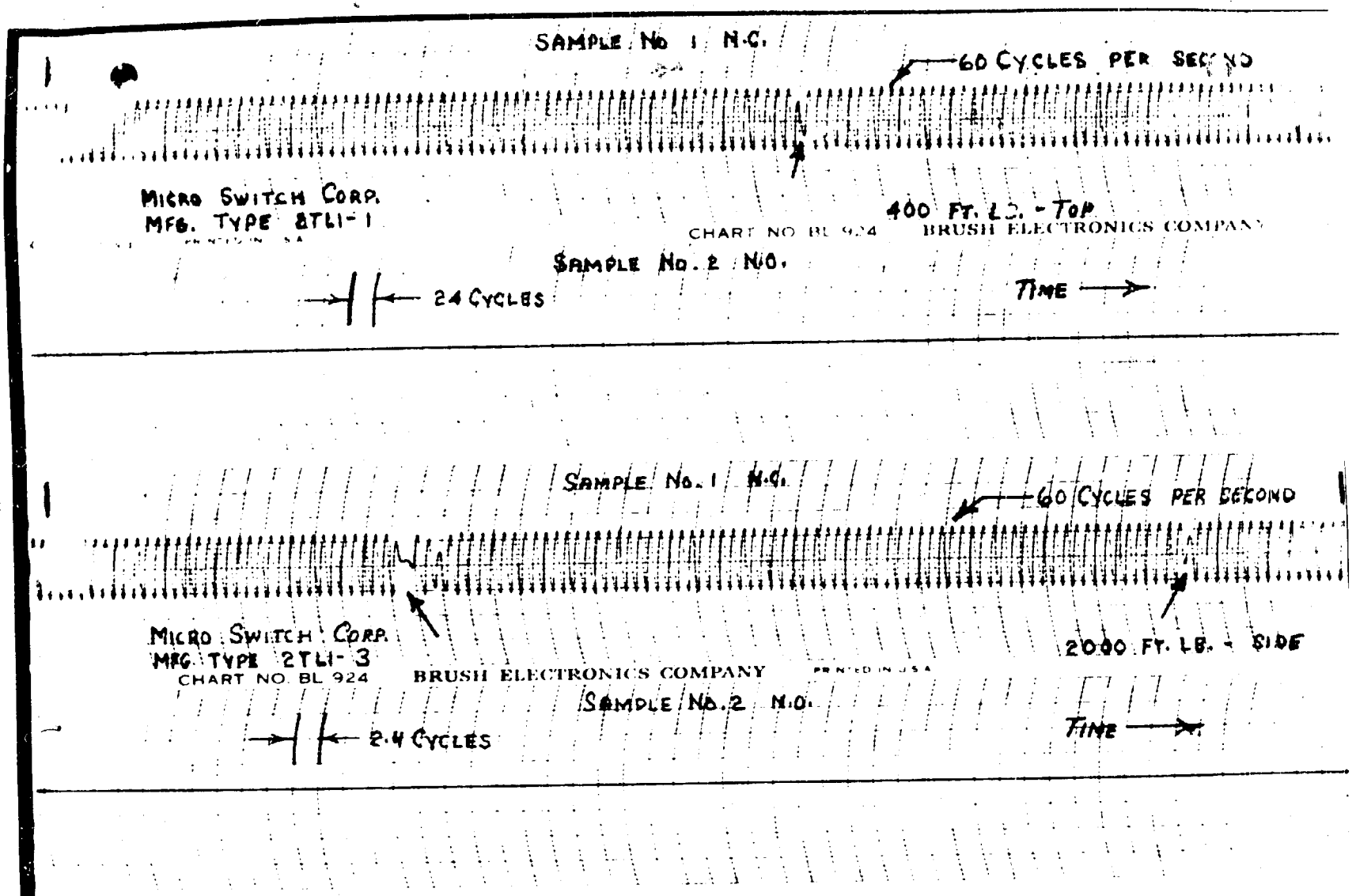
NSM 687-017 TEST No. 2994 ENCLOSURE (5)



BOTH SAMPLES BECAME DISASSEMBLED DURING IMPACT.

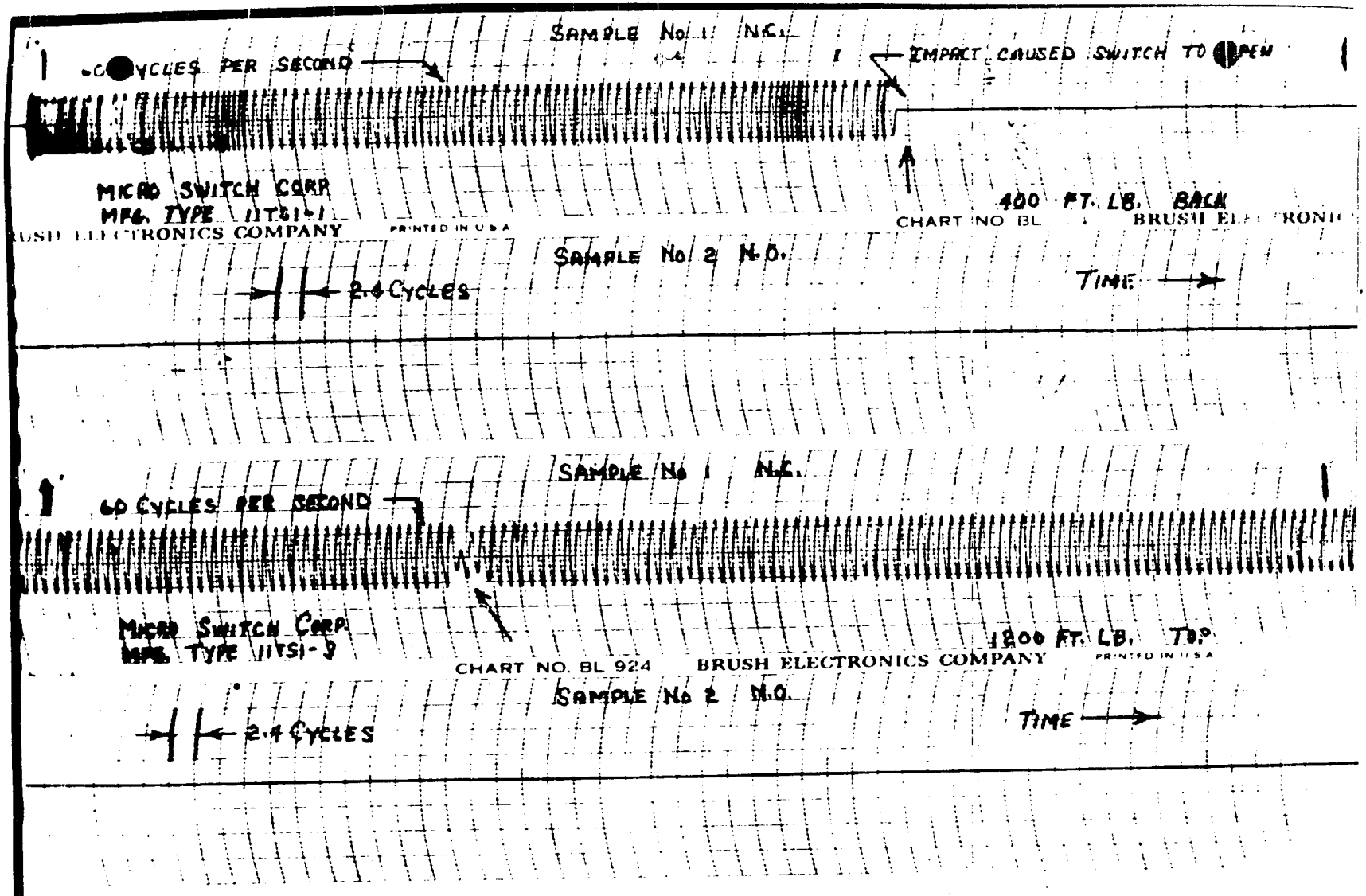
OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017 TEST No. 2994 ENCLOSURE (5) SHEET 2



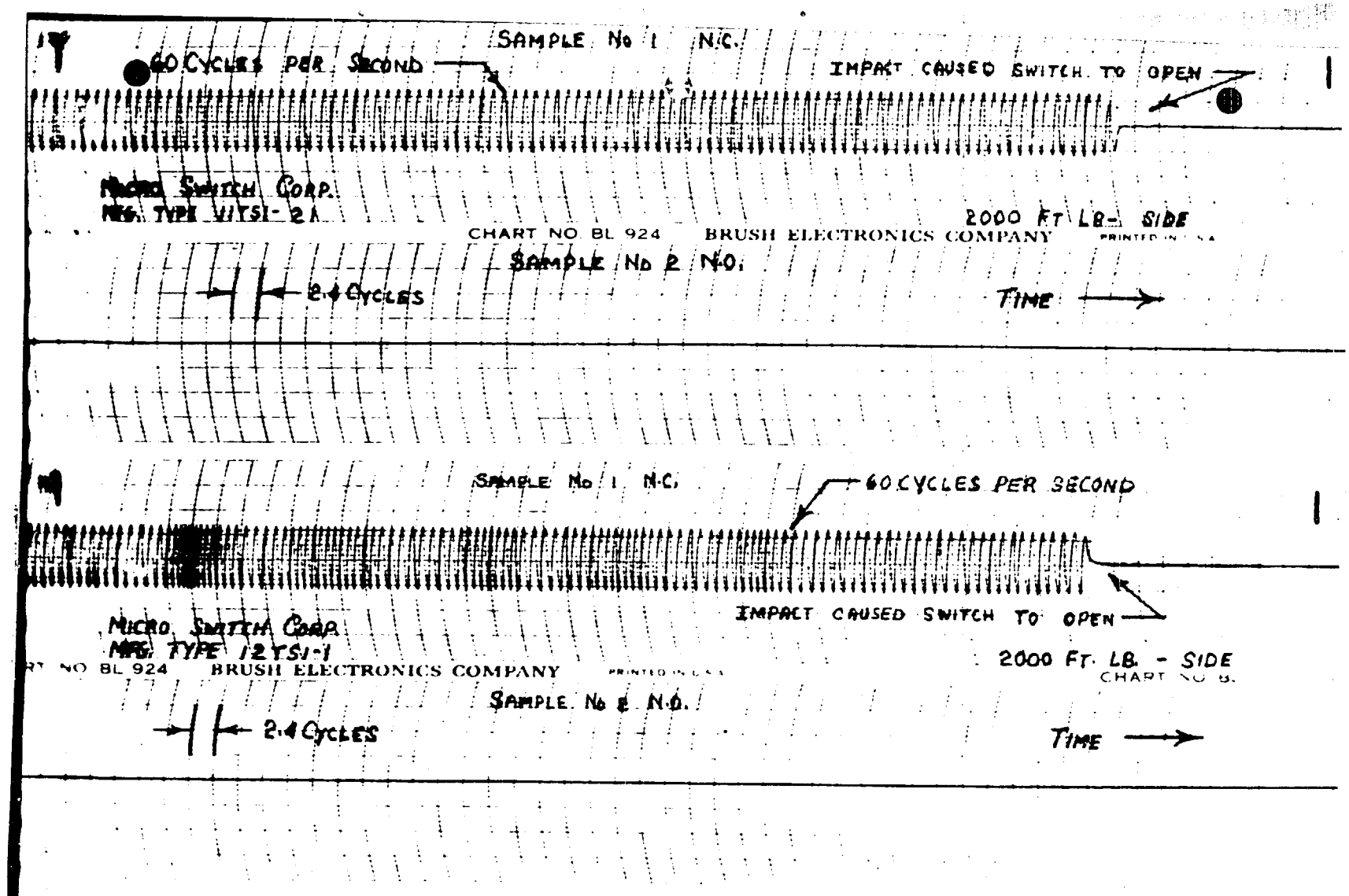
OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017 TEST No. 2994 ENCLOSURE (5) SHEET 3



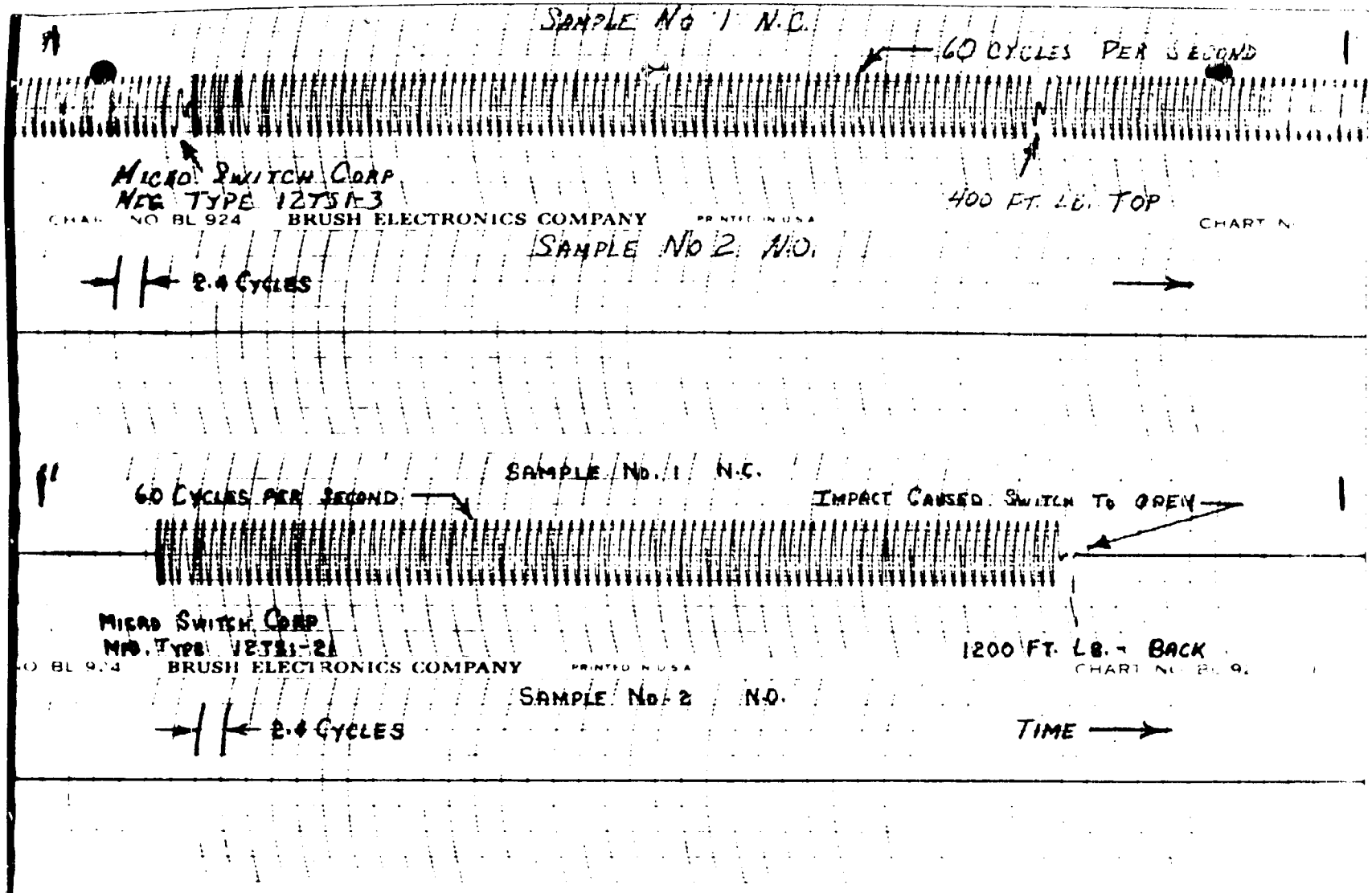
OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017 TEST No. 2994 ENCLOSURE (5)
SHEET 4



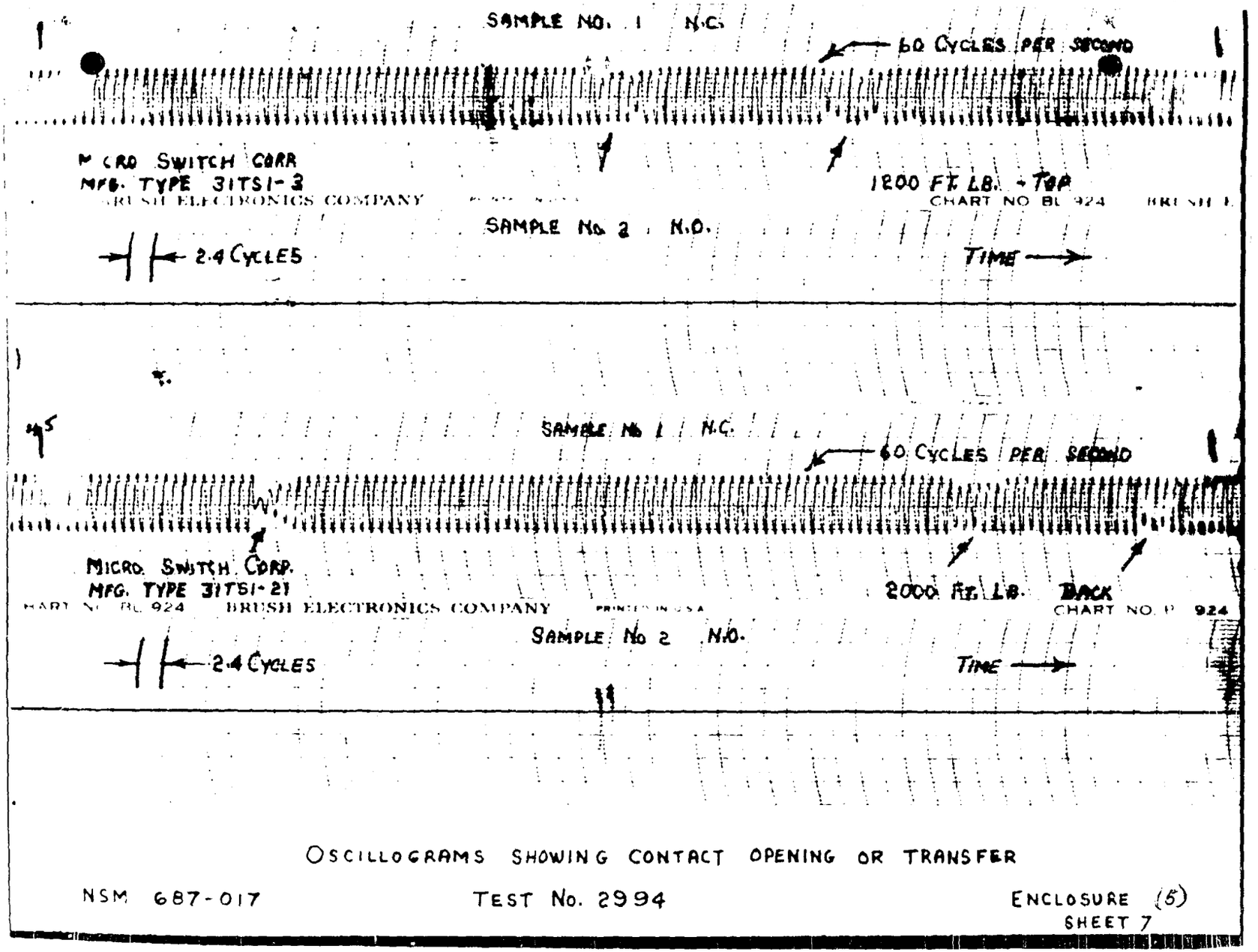
OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017 TEST No 2994 ENCLOSURE (5) SHEET 5



OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017 TEST No 2994 ENCLOSURE (5) SHEET 6



OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017 TEST No. 2994 ENCLOSURE (5)
SHEET 7

SAMPLE No. 1 N.C.
(NOT IN CIRCUIT)

MICRO SWITCH CORP.
MFG. TYPE 31TS1-1

CHART NO. BC 9.4 BRUSH ELECTRONICS COMPANY PRINTED IN U.S.A.

2000 FT. LO. - BACK

SAMPLE No 8 NO.

2.0 CYCLES

TIME →

SAMPLE No 1 N.C.

60 CYCLES PER SECOND

MICRO SWITCH CORP.
MFG TYPE 31TS1-3

400 FT. LO. - BACK

BRUSH ELECTRONICS COMPANY PRINTED IN U.S.A.

CHART NO.

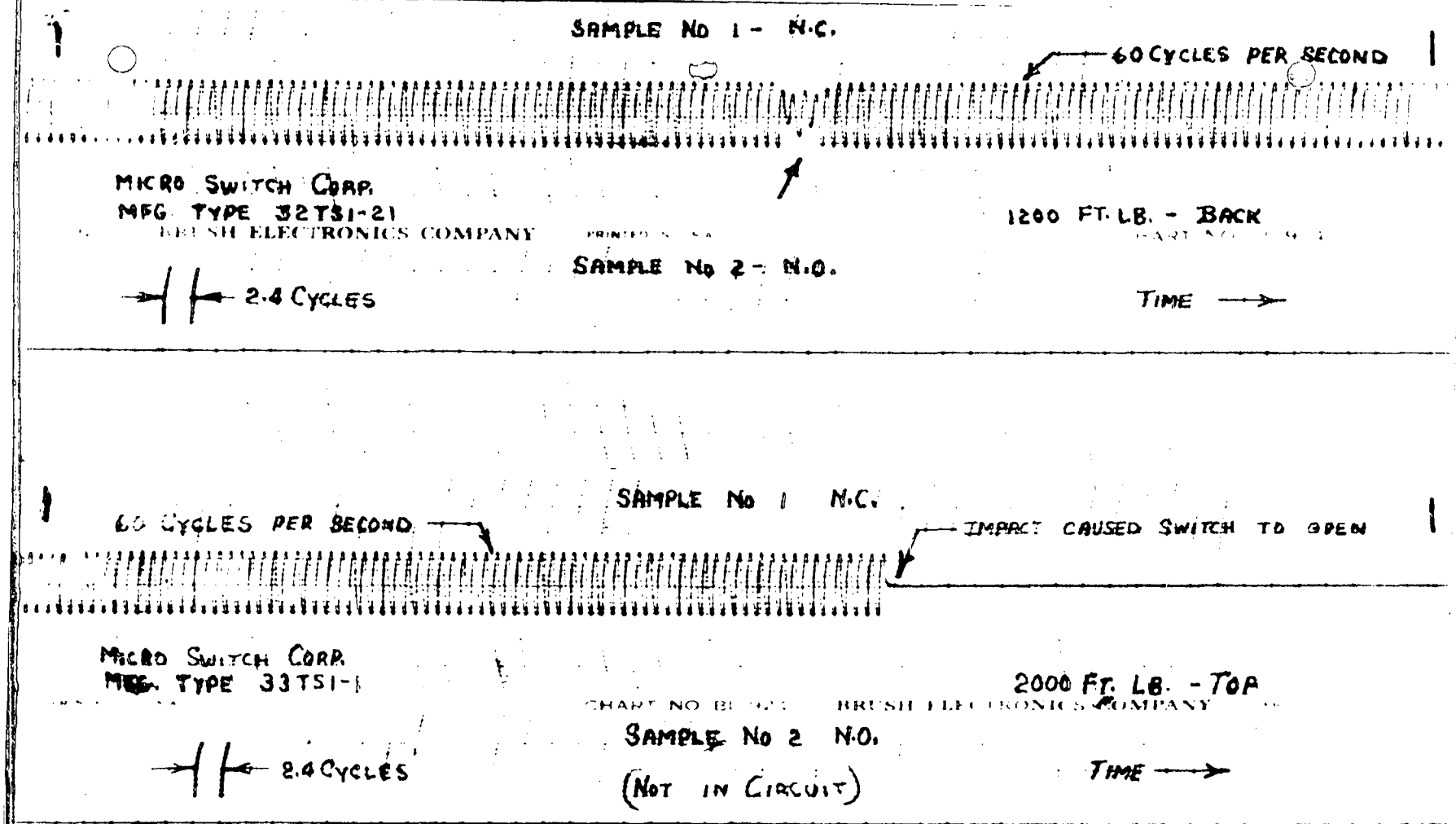
SAMPLE No 2. N.O.

2.0 CYCLES

TIME →

OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017 TEST No. 2994 ENCLOSURE (5)
SHEET 8

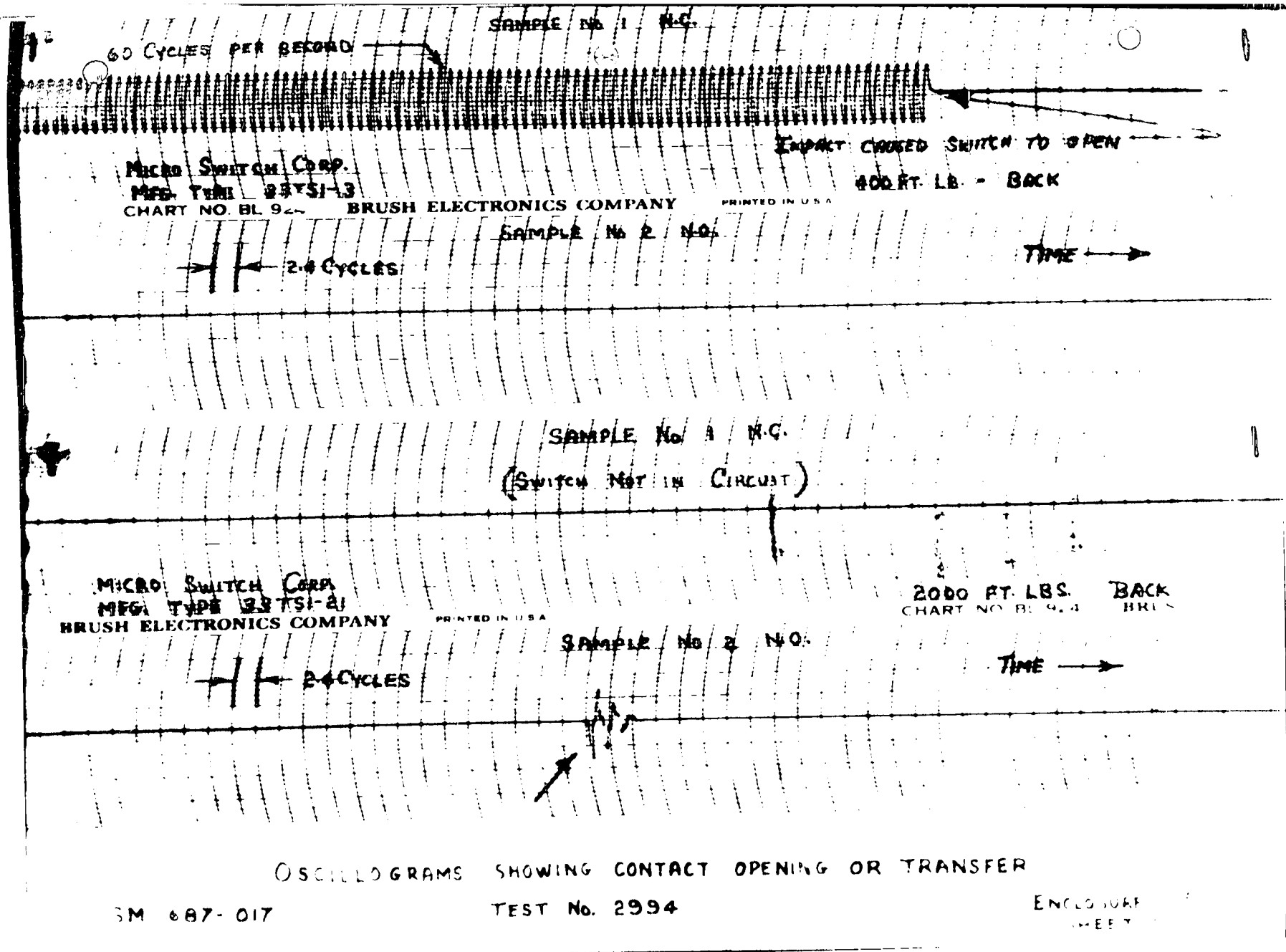


OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017

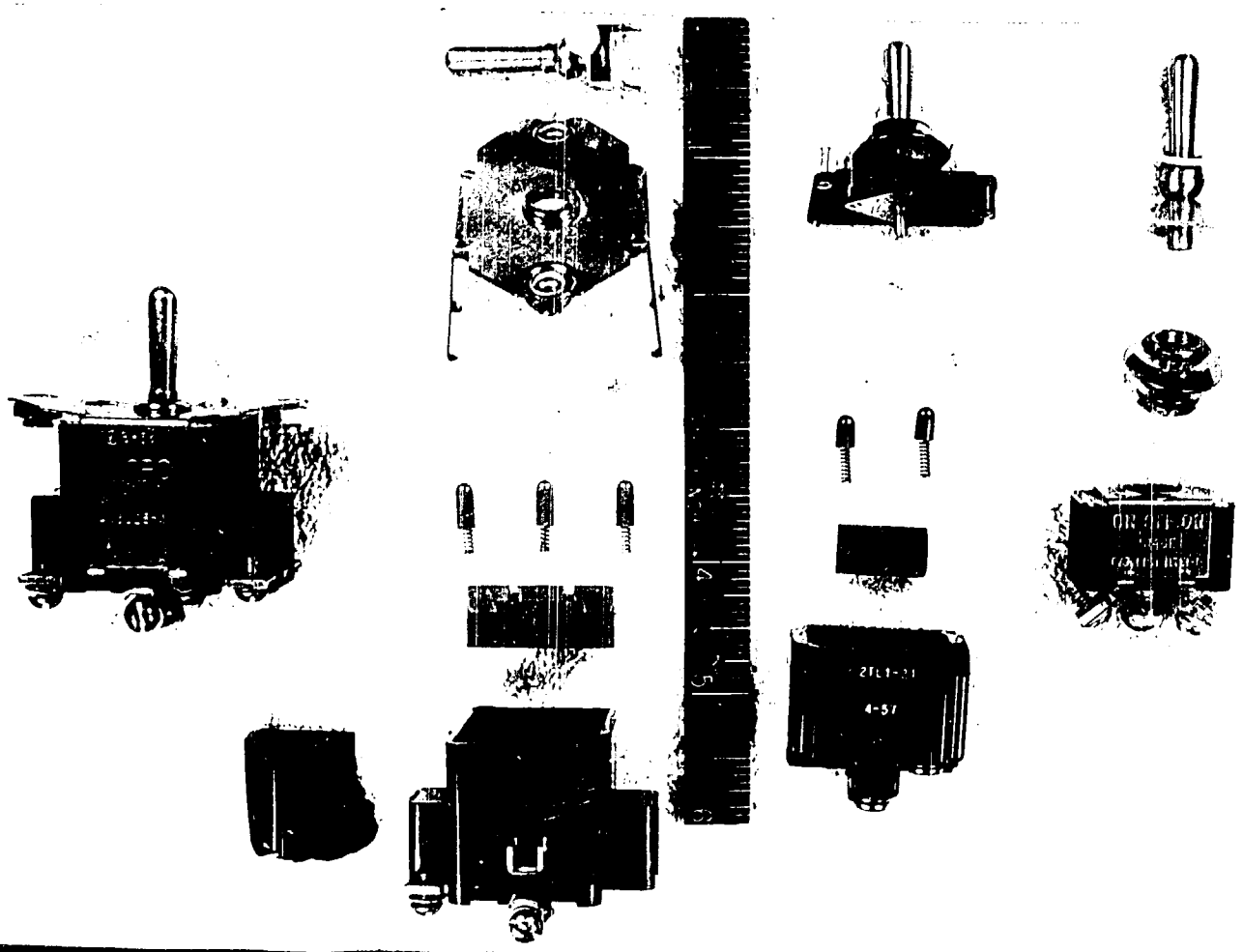
TEST No. 2994

ENCLOSURE 5
SHEET 9



OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

SM 687-017 TEST No. 2994 ENCLOSURE SHEET



(9-25-58 - 3174

TYPICAL EXAMPLES OF DAMAGE TO MICRO SWITCH CORPORATION TOGGLE SWITCHES AS A RESULT OF HIGH IMPACT SHOCK TEST

11TS1-1 2TL1-2 33TS1-21 33TS1-1

NSM687-017 TEST NO. 2994 ENCLOSURE (6)

Report of high impact shock test on toggle switches, mounted on a steel plate, as shown in figure 60 of reference (d) -

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
1TL1-1	1	N. C.	Back	400	Switch opened under impact
		N. C.	Back	1200	Switch opened under impact
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Switch opened under impact
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	Switch opened under impact
		N. C.	Side	2000	Switch opened under impact
1 TL1-1	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
1TL1-3	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Indication of contact bounce
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
1TL1-3	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce

Enclosure (7)

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
1TL1-21	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch opened under impact
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Switch opened under impact
1TL1-21	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
2TL1-1	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch opened under impact
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce - Examination after test indicated mounting bracket had distorted slightly.
2TL1-1	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce - Examination after test indicated mounting bracket had distorted slightly.

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
2TL1-3	1	N. C.	Back	400	No damage or indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Indication of contact bounce. Locking nut came loose from shaft threads permitting switch to become disassembled from shock plate. Remounted to test plate. Test continued.
		N. C.	Top	400	No damage or indication of contact bounce.
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce. Examination indicated distortion of the mounting shaft threads.
2TL1-3	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce. Two of the rivets securing the mounting plate to the switch body loosened and fell out.
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	Interior of switch fell out, after remaining two rivets broke.
2TL1-21	1	N. C.	Back	400	Indication of contact bounce. Switch mounting plate loosened from switch body.
		N. C.	Back	1200	Switch became disassembled. Test discontinued.
2TL1-21	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	Switch became disassembled. Test discontinued. Switch housing fractured.
11TS1-1	1	N. C.	Back	400	Switch opened under impact. Sample appears to be loose on mounting shaft.
		N. C.	Back	1200	Switch became disassembled. Test discontinued.
11TS1-1	2	N. O.	Back	400	Switch mounting shaft appears to be loose at body entrance.
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	Switch became disassembled. Test discontinued

Manufacturer Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
11TS1-3	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Indication of contact bounce
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
11TS1-3	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
11TS1-21	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Top	1200	Switch opened under impact. When checked, switch could not be operated and was removed from the plate. Switch could then be operated and was subjected to side impacts.
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	No damage or indication of contact bounce
		N. C.	Side	2000	Switch opened under impact
11TS1-21	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
12TS1-1	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch opened under impact
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Switch opened under impact
12TS1-1	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce - Examination after completion of test indicated shaft had loosened on switch body on both samples.
12TS1-3	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Indication of contact bounce - The shaft was found to be slightly loose on the switch body.
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
12TS1-3	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce - The shaft was found to be slightly loose on the switch body.
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
12TS1-3	2	N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
12TS1-21	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch grounded during impact causing blown fuse.
		N. C.	Back	2000	Switch opened during impact. Mounting shaft loosened.
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
12TS1-21	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
31TS1-3	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Indication of contact bounce
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	No damage or indication of contact bounce
		N. C.	Side	2000	No damage or indication of contact bounce
31TS1-3	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
31TSL-3	2	N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce - Examination after test indicated slight distortion of mounting bracket on both samples.
31TSL-21	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Indication of contact bounce
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
31TSL-21	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce - Examination after test indicated slight distortion of mounting bracket on both samples
32TSL-1	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch, when checked for operation after impact, could not be opened - Test discontinued.
32TSL-1	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	Switch momentarily closed during impact and could not be opened - Test discontinued
32TSL-3	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch opened under impact. Internal damage detected. Test discontinued

Enclosure (7)

Sheet 7

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
32TS1-3	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
32TS1-21	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Top	1200	No damage or indication of contact bounce
		N. C.	Top	2000	No damage or indication of contact bounce
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
32TS1-21	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
33TS1-1	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch opened under impact
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Switch opened under impact
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce. Mounting bracket was distorted and side plate was loose.

Manufacturer's Switch Type	Sample No.	Test Position	Direction of Impact	Impact (Foot Pounds)	Remarks
33TS1-1	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	Switch became disassembled as a result of the impact - Test discontinued
33TS1-3	1	N. C.	Back	400	Switch opened during impact. Lack of continuity in switch - Test discontinued
33TS1-3	2	N. O.	Back	400	Switch lost continuity as a result of impact - Test discontinued
33TS1-21	1	N. C.	Back	400	Switch opened under impact
		N. C.	Back	1200	Switch became disassembled. Test discontinued
33TS1-21	2	N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	Switch became disassembled. Test discontinued

NOTES; Test Position - N. C. indicates normally closed contacts.
Test Position - N. O. indicates normally open contacts.

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